

WHAT IS CLAIMED IS:

1. A protection circuit for power management semiconductor devices having a collector, a gate, and an emitter, the circuit comprising:

a first comparator which detects a collector voltage of said power management semiconductor device to output a first detection signal when the detected collector voltage exceeds a first reference voltage;

a second comparator which detects a gate voltage of said power management semiconductor device to output a second detection signal, when the detected gate signal exceeds a second reference voltage which is a minimum gate voltage for feeding a rated power to said power management semiconductor device or over, and less than a line power voltage of a drive circuit for outputting a drive signal that drives said power management semiconductor device;

logic means for outputting a protection start signal when both the first and second detection signals are being outputted; and

gate voltage reduction means for reducing said gate voltage in accordance with the protection start signal from said logic means.

2. The protection circuit for power management semiconductor devices according to claim 1, wherein said second comparator detects said gate voltage based on a voltage separated by a separation resistance for separating a gate voltage of said power management

semiconductor device.

3. The protection circuit for power management semiconductor devices according to claim 1, wherein said gate voltage reduction means cuts off a drive signal of said drive circuit and reduces said gate voltage such that it sequentially decreases.

4. The protection circuit for power management semiconductor devices according to claim 2, wherein said gate voltage reduction means cuts off a drive signal of said drive circuit and reduces said gate voltage such that it sequentially decreases.

5. The protection circuit for power management semiconductor devices according to claim 1, wherein the first reference voltage of said comparator is a collector voltage during the time when said power management semiconductor device is electrically continuous, or over, and less than a line power voltage of said drive circuit.

6. The protection circuit for power management semiconductor devices according to claim 2, wherein the first reference voltage of said comparator is a collector voltage during the time when said power management semiconductor device is electrically continuous, or over, and less than a line power voltage of said drive circuit.

7. The protection circuit for power management semiconductor devices according to claim 3, wherein the first reference voltage of said comparator is a

collector voltage during the time when said power management semiconductor device is electrically continuous, or over, and less than a line power voltage of said drive circuit.

8. The protection circuit for power management semiconductor devices according to claim 4, wherein the first reference voltage of said comparator is a collector voltage during the time when said power management semiconductor device is electrically continuous, or over, and less than a line power voltage of said drive circuit.

9. The protection circuit for power management semiconductor devices according to claim 1, wherein said first comparator, second comparator, logic means, and gate voltage reduction means are formed in semiconductor integrated circuits together with said drive circuit.

10. The protection circuit for power management semiconductor devices according to claim 2, wherein said first comparator, second comparator, logic means, and gate voltage reduction means are formed in semiconductor integrated circuits together with said drive circuit.

11. A power converter for converting AC current to DC current, the converter comprising:

a power semiconductor device for converting DC current to AC current;

a power management semiconductor device which

controls a switching operation of said power semiconductor device;

a first comparator which detects a collector voltage of said power management semiconductor device to output a first detection signal when the detected collector voltage exceeds a first reference voltage;

a second comparator which detects a gate voltage of said power management semiconductor device to output a second detection signal when the detected gate signal exceeds a second reference voltage which is a minimum gate voltage for feeding a rated power to said power management semiconductor device or over, and less than a line power voltage of a drive circuit for outputting a drive signal that drives said power management semiconductor device;

logic means for outputting a protection start signal when both the first and second detection signals are being outputted;

gate voltage reduction means for reducing said gate voltage in accordance with the protection start signal from said logic means; and

computer processor means for controlling the ON/OFF operation of said power management semiconductor device.

12. A hybrid electric vehicle having an internal combustion engine, an electric motor, a transmission for transmitting power from said internal combustion engine and/or said electric motor to wheels, an

inverter unit for converting DC power to AC power, and a DC power storage unit, wherein

said electric motor is an AC motor driven by AC power from said inverter unit, and

said inverter unit is the power converter according to claim 11.

13. An electric vehicle having an electric motor, a transmission for transmitting power from said electric motor to wheels, an inverter unit for converting DC power to AC power, and a DC power storage unit, wherein

said electric motor is an AC motor driven by AC power from said inverter unit, and

said inverter unit is the power converter according to claim 11.